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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/768,195	01/23/2001	Hiroki Endo	KNI-145-A	1960

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CARRIER, BLACKMAN & ASSOCIATES, P.C.
24101 NOVI ROAD #100
NOVI, MI 48375

EXAMINER

KIELIN, ERIK J

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 04/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

AC

Office Action Summary	Application No. 09/768,195	Applicant(s) ENDO ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10-12 and 14-23 is/are pending in the application.
 4a) Of the above claim(s) 14-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10-12 and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This action responds to the Amendment filed 17 January 2004.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Application Publication 2001/0029111 A1 (**You et al.**) in view of the Handbook of Low and High Dielectric Constant Materials and Their Applications, Nalwa, ed.; Academic Press: San Diego, 1999, pp. 52-53 (the **Handbook**, hereafter).

Regarding claims 1 and 9, **You** discloses a method of forming a coating film in an isolated process chamber which allows spin-on of low dielectric materials, solvent evaporation and curing, all under a controlled environment comprising,

applying a raw material of low dielectric constant (paragraphs [0072]-[0073] and [0139]) onto a surface of a plate-like material 208 (Fig. 2) to be treated;

reducing the oxygen concentration in the atmosphere surrounding the plate-like material to be less than or equal to 1% before a surface temperature of said plate-like material to be treated rises to 200 °C (paragraph [0153]); thereafter

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heating said plate-like material to be treated to a temperature greater than or equal to 400 °C while maintaining the oxygen concentration in the atmosphere surrounding the plate-like material to be less than or equal to 1% (paragraphs [0146]-[0147]); and then

continuing to maintain the oxygen content in the atmosphere to be less than or equal to 1% while the surface temperature of said plate-like material to be treated is lowered to 200 °C (paragraph [0153]).

Note paragraph [0153] states, "The combination of step-ramp curing and an **inert gas environment** for **heating, high temperature cure, and cooling steps** can provide thin films with high mechanical strength and minimized oxidation, therefore leading to thin films having lower dielectric constants, such as below about 3.0." (Emphasis added.) Accordingly, the heating, curing, and cooling steps in the above-mentioned paragraphs are carried out in an atmosphere of 0% oxygen because an "inert atmosphere" is used. Note also that the same purpose for using the no/low-oxygen environment in **You** is the same as that indicated by Applicant. (See instant specification section entitled "SUMMARY OF INVENTION.")

Regarding claim 2, Fig. 1a of **You** discloses purging gas lines 130 to control the chamber atmosphere. Nitrogen gas as the inert atmosphere is disclosed in paragraph [0153].

As applied to each of claims 1 and 2 **You** does not teach that the low k dielectric material has a carbon content of 5 to 25 atomic %.

The **Handbook** teaches the methylsilsesquioxane (MSSQ), a sibling compound to HSQ, is known for use in microelectronic electronic circuits for an interlayer dielectric and provides a lower dielectric constant than HSQ as well as greater thermal stability and crack resistance. The

Handbook also teaches that the curing temperature is about 400 °C, which is consistent with the temperatures used for HSQ in **You**.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use MSSQ as the low k dielectric in **You**, because **You** suggests that the method disclosed therein is appropriate for both organic and inorganic, low-k, spin-on dielectrics for use as interlayer dielectrics --specifically HSQ-- (**You**, paragraphs [0072]) and because the **Handbook** teaches that **MSSQ is better than HSQ**.

Finally, given the stoichiometry of MSSQ, there is 1 carbon atom per 7.5 atoms (the hypothetical 0.5 atom being the bridging oxygen), which is 13.5 atomic % carbon. Similarly, given the gram atomic weights of carbon, hydrogen, oxygen and silicon, the weight percent carbon is 14.4%.

Moreover, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more

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ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960) ("Mere selection of known plastics to make container-dispenser of a type made of plastics prior to the invention, the selection of the plastics being on the basis of suitability for the intended use, would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.") (See MPEP 2144.07.)

3. Claims 3, 7, 8 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** as applied to claim 1, above, and further in view of US 5,431,700 (**Sloan**).

The prior art of **You** in view of the **Handbook**, as explained above, teaches all of the features of the claims except for controlling the surface temperature of the wafer by selectively moving the wafer relative to a hot-plate positioned over a cold plate (claims 3 and 7) while the moving is carried out by a elevator means extending through the cold plate (claim 8), as shown in Applicant's Fig. 2.

Sloan teaches a method of controlling the surface temperature of a semiconductor wafer **12** (plate-like material) for heating and for cooling operations using a hot plate **26** positioned over a cooling plate **42** with elevator means **70** having pins **62** extending through the cooling plate (cover Fig.; paragraph bridging cols. 4-5).

It would have been obvious to one of ordinary skill at the time of the invention to use the temperature control method taught by **Sloan** in the method disclosed by **You** in view of the **Handbook** for the many beneficial reasons indicated in **Sloan**, such as uniform heating, reduced

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contamination, etcetera. (See **Sloan** Abstract.) Moreover, **You** specifically indicates that the wafer chuck can be cooled

Regarding claim 23, **You** discloses that the wafer chuck **104** is cooled (paragraph [0055]) making in similarity to the **Sloan** cooling plate **42**. **You** also teaches that the wafer is placed on the wafer chuck --i.e. the cooling plate-- and **then** the gas atmosphere is adjusted (paragraph [0058]). Accordingly, **You** discloses that the wafer is moved close to the cooling plate --i.e. the cooled wafer chuck-- prior to reducing the oxygen concentration to less than 1%. Moreover, one of ordinary skill would know to move the wafer to the cooling plate of **You** in view of **Sloan** prior to the reducing step because **You** states that the wafer is placed on the cooled wafer chuck prior to adjusting the gas composition of the atmosphere.

4. Claims 4 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** as applied to claim 1, above, and further in view of either of Applicant's admitted prior art (**AAPA**) and **Wolf**, Silicon Processing for the VLSI Era, Vol. 2 : Process Integration, Lattice Press: Sunset Beach, CA 2000, pp. 797-801.

The prior art of **You** in view of the **Handbook**, as explained above, teaches all of the features of the claims except for further processing an interlayer insulation layer by a damascene method.

Each of **AAPA** and **Wolf** teaches the reasons it is common in the art to process an interlayer insulation layer of low dielectric constant by a damascene method, in order to interconnect semiconductor devices. (See instant specification, section entitled "Description of Prior Art" and associated Figs. 1(a)-1(h). See also **Wolf**, pp. 797-801 -- especially Fig. 15.60).

It would have been obvious to one of ordinary skill at the time of the invention to process the interlayer insulation film of **You** in view of the **Handbook** by a damascene method as taught by either of **AAPA** and **Wolf** in order to form interconnect for semiconductor devices, which is essential in the art and because the **You** method and dielectric materials and the **Handbook** dielectric materials are for the formation of interlevel dielectrics for semiconductor devices (Abstract; paragraph [0009]).

Regarding claim 10, **You** and the **Handbook** both disclose that the interlayer insulation film beneficially has a low dielectric constant of 3.0 or less, as noted above.

5. Claims 5-6 and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **You** in view of the **Handbook** and **Sloan** as applied to claims 1-3, above, and further in view of either of **AAPA** and **Wolf**.

The prior art of **You** in view of the **Handbook** and **Sloan**, as explained above, teaches all of the features of the claims except for further processing an interlayer insulation layer by a damascene method.

Regarding claims 5 and 6, either of **AAPA** and **Wolf** is applied as above.

Regarding claims 11-12, **You** and the **Handbook** each disclose that the interlayer insulation layer beneficially has a low dielectric constant of 3.0 or less, as noted above.

Response to Arguments

6. Applicant's arguments filed 17 January 2004 have been fully considered but they are not persuasive.

Applicant appears to argue that Examiner has failed to properly consider the **You** disclosure. Examiner respectfully disagrees. **You** has been properly considered by Examiner, as stated above in the rejections.

Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). In this regard, the rejection of the claims 1, 2, and 9 is over **You** in view of the Handbook of Low and High Dielectric Constant Materials and Their Applications.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

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CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 571-272-1693. The examiner can normally be reached on 9:00 - 19:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Erik Kielin
Primary Examiner
6 April 2004